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The President announced that he had appointed Dr. Pepper, Dr. Frazer, Mr. Ingham, Mr. Jos. C. Fraley and Dr. Hays the Committee for the special meetings agreed upon at the last meeting of the Society.

The Society was adjourned by the President.

Eucalyptus in Algeria and Tunisia, from an hygienic and climatological point of view.

By Dr. Edward Pepper.

(Read before the American Philosophical Society, March 6, 1896.)

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I.

DIVISION OF ALGERIA AND TUNISIA INTO THREE ZONES AS REGARDS CLIMATE, WATER, TREES, HEALTH AND POPULATION.

Division of Algeria and Tunisia into three zones as above indicated. Algeria and Tunisia are properly divided into three zones as regards climatological, hydrological and botanical, as well as hygienic and ethnographic conditions.*

The southern zone, The Sahara, consisting generally of a vast area of sand, moving and yet in parts solidified as by petrifaction (hamada), inhabited by semi-barbarous and-roving tribes; and of oases of date-palms, inhabited by settled and less barbarous communities.

The middle zone comprises the high plateaux, or steppes, covered with a wild vegetation (herbaceous, fructiferous and rarely arborescent)

* As regards purely hydrographical conditions, these countries are divided into only two zones: the basin of the Mediterranean and that of the desert, all water not flowing in the one flowing in the other direction. But as regards practical hydrology or hydroscopy and its influence on the climate, these colonies are, as stated, properly divided into three zones here described.

and sustaining numerous flocks of sheep and camels ; also sparsely inhabited.

Finally the northern zone, or coast region, El Tell, is generally cultivated and much better watered and wooded, and has both plains and valleys, hills and mountains. Here the European population of three or four hundred thousand only slowly increases by birth as well as by immigration, among three or four million more prolific lowland Arabs and Kabyle mountaineers.

The Algerian and Tunisian year has but two seasons : the dry and the wet. The former or summer comprising three rainless months, July–October, and the latter or winter months, October–March, offering generally short and frequently heavy showers and rains, and four months of showers lighter and fewer as the season draws to its close. The transition between these seasons is often sudden, an almost vertical sun radiating great heat over the land as soon as the cloud-screens have disappeared from the atmosphere.

Local climates abound in the coast region. A peculiarity of the coast region (the Tell) is the diversity of the local climates (in most cases improperly called artificial) due to geological and geographical conditions, such as the nature, conformation and lay of the land as regards the higher hills and mountains, valleys and rivers, the sea, lakes, etc.; and also to orographical characteristics, such as the height of the mountains, the depth of these valleys, etc.; as well as to hydrological facts, such as the presence, absence, abundance or scarcity of the waters, flowing or stagnant, either above or underground. These local climates also depend on the extent of the surface cultivated, and, to a lesser degree, on the nature of the plants grown. A soil left to, or returning to nature, such as that of the most northern Africa after the Arab conquest, is ever harmful ; the Corsican *mâquis*, the Indian jungle, the African brush, the Australian bush, etc., are among the strongholds, and so to say the lairs of disease, especially of malarial disease.

Moreover, the winds that blow over a country exercise the greatest of all influences on climate and vegetation, and consequently on health. There are parts of northern Africa, as of Asia, of America and of Australia, and even limited parts of Europe, where a progressive population can never dwell, while the physical causes actually at work exist.

In the coast region of Algeria the same communes, nay even the same towns frequently exhibit different climates in their different parts. Thus, Algiers itself has distinctly two local climates : that of the Bab-eloued and Marengo quarter is more bracing, that of the Bab-Ozoun and Isly more relaxing. These differences are of great importance to the sojourners generally and especially to invalids passing the winter in Algiers ; and they are even more marked in the suburbs of St.

Eugène with its northeastern and of Mustapha with its exposure southeastern, the latter being under the predominating influence of the extensive Bay of Algiers.

The mountains of this region have generally a dry and bracing air, with severe cold in winter in the higher altitudes, where snows last through many months, and where even cases of frozen extremities are not rare. These highlands would in summer have great attractions and advantages as climate stations if they possessed suitable accommodation for sufferers from the heat, debility, or malaria, prevalent in so many parts of the lowlands. Such sanatoria would, in many cases, do away with the necessity of the yearly trip to Europe, habitual with an ever-increasing class of the population.

General climate the sum of the local climates. The general climate in this region, as elsewhere, is but the sum of local climates, with their differences of heat, cold and dampness. As to the latter, it is noticeable that the atmosphere is almost saturated on and near the seashore during the summer, excepting when the wind blows from the desert lying to the south and principally to the southeast; the dampness being at its maximum when the northeast wind blows; while further inland the dampness diminishes and finally disappears. Thus, on the seashore and in its proximity the air contains less moisture in winter, although it is the rainy season then and the moisture is most manifest; that of summer being more perfectly dissolved in the air, and (excepting when the northeast winds blow) being recognized more readily by the hygrometer. The rainy winter months are naturally the damp months in the interior.

Algeria and Tunisia were well-wooded and healthier in ancient times. In the prosperous days of old, Algeria and Tunisia were relatively thickly wooded, as were most of the countries bathed by the Mediterranean, and they were doubtless more healthy than now. The mountains and hill-sides, the plains and alluvial levels of the Tell, as well as some parts of the high plateaux, have appropriate soil for trees, which in the former region would still abound if not systematically ruined by the fires kindled by the Arabs,* and the abuse of pasturage, their almost universal waste of wood, resins and barks, among which may be cited valuable cork and tannin barks.

Extent of woods remaining as compared to that of France. Actually the fourteen million hectares of the Tell have less than fourteen hundred thousand hectares of forests left, offering scrub or brush, and less frequently, although there are fine exceptions, forest trees; as compared to the seven or eight million of

* And yet new growths frequently spring up from the ashes of these fires, under the teeth of the cattle, so to speak; but only to be fired again to produce new pasturage, until finally in this weakly and intermittent existence the beneficial influence exercised on the climate by trees is reduced to a minimum.

hectares of generally better woods remaining in France, with its surface of about fifty million hectares.

The above fact is quite sufficient to justify the alarm-cry of the Ligue du Reboisement, which, alas, has so far been "vox clamantis in deserto."

**Consequences
of the ruthless
destruction of
trees which is
still going on.**

This ruthless destruction of forests, groves and frequently of scattered trees is still going on and is the main cause of the diminution of the rainfall, the exhaustion of the soil and of the consequent unhealthiness of many sections.

**Other causes of
agricultural de-
cadence and un-
healthiness.**

Other causes of agricultural decadence and of unhealthiness have manifestly been at work in northern Africa since the Arab conquest, such as the waste of manure, which is left to breed disease around the gourbis and douars, the want of proper alternation in crops, the superficial mode of tilling and the always incomplete cultivation of even the small surface that the Arab deems strictly necessary for the maintenance of his family and domestic animals, his calculations (?) being based on an average crop.

This is not true of the Kabyle mountaineers, a different and thrifty race, comparatively progressive and who, like the Swiss, cultivate in a primitive way, it is true, yet very generally, all their soil.

**Urgent reasons
for replanting of
trees.**

To sum up, of all countries, Algeria and Tunisia, so sparsely inhabited as compared even with the less densely populated nations of Europe, require to be well provided with wood on account of the general

dryness of the climate (except on or near the seashore), the unequal distribution of the rain-fall, which occurs only during the cooler months of the year, when the heavy downpours are in a great measure wasted by the impermeable nature of the soil on the Tell, where the headwaters are torrents, and the lower and more level parts of the small rivers lose by evaporation much or sometimes even all of the water retained for any length of time in summer ; woods are needed also on account of the great variations in temperature and dampness before mentioned, and which in the middle and southern zones produce nycthemeral differences of as much as forty and even fifty degrees (centigrade), while in the northern, the hygrometer attains its extreme recording limits, now under the influence of winds immediately laden with the moisture of the sea, anon subjected to the parching action of the desert. Not only should woods be protected in these colonies, but as many trees as possible should be grown ; for is it not an axiom in climatology that (except in countries lying in the path of damp winds) a large proportion of woods is indispensable to that equable distribution of heat, cold and dampness which produces successful agriculture, a healthy climate and general prosperity ?

II.

**CHRONOLOGICAL FACTS AS TO THE GROWING OF EUCALYPTI IN
ALGERIA AND TUNISIA.**

Date of introduction of Eucalypti into northern Africa.

Commune of El Biar, four miles from town.*

Successive experiments in growing them as a preventive of malaria.

The first seeds of eucalypti consigned to the earth in northern Africa were sown in the Jardin d'Essai of Algiers in 1862, by Mr. Hardy, director of the botanical garden thus named, and in the same year by the Comte de Belleroche, who procured them from the director and sowed them in his property in the Commune of El Biar, four miles from town.*

These experiments having succeeded, the trees were soon grown to prevent malaria, still so prevalent throughout northern Africa, and which made most cruel ravages in Algeria between 1867 and 1876, while immigration and the development of the colony were receiving their greatest impulse.

The importance of preserving the public health where satisfactory, and of improving it in the more numerous districts where conditions and circumstances were against it, was, at this time, more generally recognized by the government and the people. The "Ponts et Chaussées,"† the important companies and societies, corporations, municipalities and many private individuals grew eucalypti in the principal settlements infested by the disease, believing that they had at last discovered a panacea against the evil.

In 1868 Mr. Ernest Lambert, inspector of the forests of Algeria, sowed a grove on the Bouzareah mountain, above Algiers, where now is the forest, or rather wood of Baihnen. Then Dr. Marés, at Boufarik, planted a grove on his farm, reporting to the Société d'Agriculture seven years later that the health of his neighborhood was satisfactory. Malaria in its worst forms had constantly prevailed there until then *and until the land had been successfully drained.*

During the two succeeding years, the Société Algérienne planted 100,000 eucalypti near Ain-Mokra, a village on the shore of Lake Fetzara.

The mining company of the Mokta soon followed with many still larger plantations in the same region, where the public health improved towards 1875, the mines being thenceforth worked during the summer, an impossibility until then, owing to the excessive mortality among the workmen, due principally to pernicious forms of malaria.

The latter plantations remain among the most extensive in Algeria, and offer a striking instance of the frequently great aid given by eucalypti against malaria. Thick curtains of the trees were grown between the lake and the village, while, at the same time, a draining canal was cut in

* Now known as El-Afia, and belonging to the author.

† Government engineers, entrusted with the construction and repairing of roads and bridges, and the buoying of harbors.

the shallow bed of the lake, sufficiently deep and wide (so thought the engineers) to carry off the stagnant waters and dry up the swamp. This result, however, was not attained, but yearly thenceforth the waters of the lake were emptied early enough in the spring, and before the summer heats, for the spongy shores to be covered with an herbaceous vegetation offering here and there comparatively fair pasturage. The coincidence of this partial draining with the planting of eucalypti does not permit the conclusion that the improved sanitary condition of Ain-Mokra is wholly due to these trees.

At Maison Carrée, Cardinal Lavigerie and the white Fathers, as well as MMs. Saulière, Cordier, Trottier and others sowed and planted, the first large the last small, groves of eucalypti, with a marked improvement on the health of the community, which, however, still remains far from good.

These enterprises were rapidly followed by many others, and now most Algerian villages, especially if in malarial districts, have more or less extensive groves or avenues of eucalypti, and many farms are also well provided with these trees.

III.

GENERAL AND SPECIAL ADVANTAGES CLAIMED FOR EUCALYPTI. LIMITATIONS AS TO THE USES OF AND OBJECTIONS TO THEM.

Advantages of trees in general, including eucalypti: shelter, good effect on the morale and on health. Among the advantages of trees in general, shared to a certain extent by eucalypti, is the grateful shade procured in hot countries to dwellings, and to cattle, and other domestic animals.

Trees also, including eucalypti, gratify the eye, and the latter have totally changed the aspect of the plain of the Isser river, since they have been grown around its villages and farms. This is not merely an æsthetic result. The fact has its practical importance as acting directly on the morale and therefore indirectly on the physical state of the colonist.

For trees form in the barren regions almost the only objects on which the eye rests with pleasure, recalling the triumph of man over desolate nature, diminishing in the heart of the pioneer that terrible longing for less stern realities and cherished scenes in the past, which, if not checked in time, opens the door to disease, even in the most robust constitutions.*

Forests cause the winds to ascend and produce rain. Another general advantage of trees, particularly of eucalypti, is that forests, like mountains and other barriers, as is well known, when opposed to the wind force it to rise, dilate and cool in the higher and more rarified layers of the atmosphere, whence result con-

* We remark incidentally that in Algeria and Tunisia trees are not more numerous than at the time of the French conquest; they are fewer in fact. But trees, especially eucalypti, have been grown judiciously, where most serviceable to health. The cultivation of the vine has also accomplished much good, more even than eucalypti, because so much more extensively planted.

densation, saturation of the diffused aqueous vapors and finally rain. If, as Mignet says : "A forest is worth a mountain to produce rain," then the higher and more numerous the trees, as the higher and more extensive the mountain, the greater the precipitation of water, *ceteris paribus*.* Scrub growths seem to exercise little or no influence on the rainfall, as witnessed in Greece, northern Africa and elsewhere, where this wild vegetation is principally composed of lentisci and dwarf palms, while we observe that the few million trees grown in Egypt under Mehemet Ali and his successors have brought back rains unknown for ages. This is doubtless a fair inference and not merely a coincidence due to other, such as cosmic causes.

Special advantages of eucalypti. Rapid growth. Among the special advantages of eucalypti, one of the most important for the colonist, who can ill afford to wait long for a result from his labors, is their rapid growth, as compared to that of other trees suitable to this climate, excepting perhaps some acaciae mimosæ, as shown by the following table approximately correct for an average appropriate soil and exposure :

| AGE, YEARS. | HEIGHT, METRES. | CIRCUMFERENCE, METRE. |
|-------------|-----------------|-----------------------|
| 1 | 3 | 0.10 |
| 2 | 5 | 0.15 |
| 3 | 7 | 0.30 |
| 4 | 10 | 0.40 |
| 5 | 13 | 0.55 |
| 6 | 15 | 0.75 |
| 7 | 17 | 0.90 |
| 8 | 19 | 1.10 |
| 9 | 22 | 1.45 |
| 10 | 25 | 1.60 |

Resistance to heat and to slight frost.

Antimiasmatic action.

Moreover the trees thrive where no others will, in the bad lands of these colonies, generally resisting great heat, and several species withstanding relative cold and even slight frosts and snows, as in Australia.

To their balsamic odor† is perhaps due an antimiasmatic action on the surrounding atmosphere; and certainly the constant evaporation through their leaves of the dampness taken up by the roots is a most important agent of improvement for soils needing to be drained, while these

* Bare mountains lying in the path of damp winds naturally produce torrents and landslides instead of the useful rains occasioned by wooded mountains.

† This balsamic exhalation from the young shoots, twigs, the leaves and fruit is due to an essential oil similar to that of cajeput, which being oxidized by the air, produces ozone, and which, when refined, gives eucalyptol, a sort of camphor in composition and chemical properties, most serviceable as a febrifuge, tonic stimulant, aseptic and anti-septic.

trees have not the inconveniences of some other hardy trees of a slightly less rapid growth, but also useful for draining, such as plane trees, to which are ascribed (?) many cases of conjunctivitis and keratitis, prevalent in Algeria, Tunisia and throughout the East generally.*

Frequently malaria is not due to the soil on which a village or farm is built, but to the neighborhood. In this case a heavy curtain of eucalypti interposed is always useful and often sufficient to arrest the disease. Of course the swamp, or whatever be the nature of this infectious soil, must not be too extensive or pestilential, and the curtain must be of sufficient extent and thickness.

They form open forests. The eucalypti form open forests, free from under-brush, that great temptation to the incendiary shepherd, who sacrifices health and well-being to a scant resource in actual pasturage for his flocks (see above the effect of burning down trees). If the subsoil be compact, the roots return to the surface; if permeable, they remain sometimes deep enough to allow a few scant and coarse grasses to grow between and under their shade, if the trees are far enough apart.

Their seeds prolific. The seeds are light and fertile and readily disseminated by the wind, thus propagating their species and extending plantations.

A permanent benefit to the atmosphere. The foliage is perennial; its benefit to the atmosphere (hygrometrically, electrically and antimiasmatically) is permanent.

They are killed with difficulty. Besides, many species are killed with difficulty, and when destroyed above ground by axe or saw send out numerous shoots from the stump; at first easily broken off, but finally firmly fixed, and during the first three years or so giving leaves similar to those of young trees of their age; that is, lighter in color, more flexible, sticky, cordiform, etc., and possessed of greater antimismatic virtue than the leaves of older trees.

A great protection to land against wind. It is well known that the protection of land against wind by an obstacle interposed between it and the wind is directly proportional to the height of the obstacle and approximately to twenty times that height. Therefore, eucalypti protect a much wider tract than most other trees against strong or otherwise harmful winds, such as the blighting sirocco. With a height of forty metres they protect a strip of four-fifths of a kilometre in width, the highest indigenous trees not protecting more than half this surface. The height to which eucalypti rapidly attain is, therefore, a sufficient reason for preferring them to other trees, except some *Acaciæ*, *Mimosæ*, to protect land against winds. Alternate rows of eucalypti of appropriate species can be judiciously cut down near the ground

* At Boufarik the great improvement in public health is due to plane trees, and mainly to the thorough draining of the marsh on which the village is built, and where hundreds of colonists lie buried.

and kept trimmed, so as to afford protection by the branches sprouting from their mutilated stumps against wind passing between them and the higher trunks of the rows left uncut.

Richness of their ashes in potash. Finally, ashes of the eucalypti contain more potash than those of most European or North American trees.

A resource as firewood. For kindling and firewood, as fully described further on, most eucalypti offer no advantages, although serviceable when other woods are scarce and dear, and constituting a precious resource in these colonies against the ever-increasing price of fuel.*

Necessary limitations to their climatological and hygienic advantages. Naturally eucalypti have their limitations, as has every useful plant in nature, and it is a well-known fact that they have not materially improved the unfavorable conditions of disease-breeding soil and atmosphere in the oases, where the former remains undrained and indeed undrainable, except at the sacrifice of fruitful vegetation, lost as are these favored spots in the immense desert of ever-heated sands. Again, even the most extensive forests of eucalypti cannot neutralize the poison of very large swamps or of flatlands inundated only throughout the winter, as is the bottom land containing Lake Fetzara, already mentioned, where the trees cannot be planted with success, either on account of the excessive moisture of the ground or by reason of its brackishness resulting from the great evaporation.†

It would, indeed, be expecting too much from eucalypti to count upon their counteracting in Northern Africa all the evil influences at work in many parts, and which in other countries they have been vainly expected to overcome.

Italian reports conflicting. The Italian reports are not generally favorable to eucalypti, nothing decisive, it seems, having been ascertained as to their superiority over all other trees in rendering less unhealthy the immense swamps of the Roman Campagna. It must be conceded that the climate of Italy is less favorable to these trees than that of the Algerian and Tunisian coast regions. However, as noted by De Pietra Santa,‡ "Malaria remains prevalent and

* Mr. E. Lambert, before quoted, claims other special advantages for the eucalypti, such as their immunity from the mandibles of the locusts, who devour other vegetation and even linen; and he mentions the protection their shade would afford to the thrush, black birds and other locust-eating birds if these trees were more extensively grown in the barren plains. He also claims that their foliage and bloom would feed the honey bee, as in Australia, whereas apiculture is now generally confined to the mountains, which are better wooded and less parched in summer, when, in spite of the heat, the insects remain active in this climate.

† "*Eu. restrata* lives in water containing as much as 1 per cent. of chloride of sodium, but with as much as 1.50 per cent. good results are rare" (Dr. Trabut, Professor of Natural History at School of Medicine of Algiers).

‡ Pietra Santa, "Assainissement de la Campagne Romaine," *Journal d'Hygiène*, 1881-1883. Also *Genie Civil*, May, 1883, Vol. iii, p. 312.

severe in the very districts of the Campagna of all others where it was expected that the disease would have been stamped out, so to speak, by the general planting of eucalypti, especially when, as was the case in many of these places, vigorous cultivation of the soil was added to their expected action."

Australian reports prove a limited antimiasmatic action against powerful causes of malaria.

If now we turn to Australian reports, we remark, as recognized years ago by Prof. Liversidge, of the University of Sidney, that: "Malaria is far from rare in the vast forests of eucalypti of Australia." Although without doubt these trees have always a beneficial action, this is not sufficient, as previously stated, to overcome the powerful causes of unhealthiness that are at work in many places. Referring to this point, Tomasi Crudeli* justly remarks that: "If all malarial soils had the same chemical composition and were similar topographically (and we may add if they had the same climate), then, perhaps, these trees could be expected to improve the unhealthy soils, so as greatly to attenuate or even to eradicate the disease, if at the same time all the diverse modes of improvement which have succeeded in rendering some of them healthy were applied; at least, we could only be justified under such circumstances in expecting a good result. Unfortunately, malaria is bred in very dissimilar soils, and we even recognize its presence on the granitic plateau of Castille. So that systems of soil improvement applicable to some malarial regions are useless in others. Until now we have proceeded empirically wherever we have introduced eucalypti, and such will be the case until a long series of scientific observations and researches, combined with practical experiments, shall have furnished exact information as to each distinct variety of soil which produces malarial poison."

If such be really the fact, let us trust that the dawn is breaking, and that each ray of light thrown on the subject even by such short papers as this (be the ray never so weak) may, when collected into a beam, aid us in seeing where the truth lies.

Objections to eucalypti as being ugly, as being deficient in shade, as twisting their fibre to the left, as not growing with other trees and as not being remunerative.

Objections have been and are still urged against eucalypti. We will only refer to them here, adding a word or two of refutation. This first objection is that they are ugly. This, however, is only relative, and does not extend to all species, some being quite ornamental. The second is that their leaves hang vertically and give incomplete protection against sun or rain. But such protection is preferable to none, surely. Another is their strong tendency to twist to the left,† which greatly interferes with their being sawed into

* Tomasi Crudeli, "La malaria de Rome et l'ancien drainage des collines Romaines." Lecrosnier, 1881.

† This levogyration, which constitutes the main objection to eucalypti, after the consideration that they are unremunerative, has never, as far as known, been explained satisfactorily. It is, however, much less manifested, as here noted, in close and extensive plantations, and there is a marked difference among the species as to twisting. But why is this twisting ever to the left, without regard to the direction of the wind?

planks; but this twisting can be lessened in many cases by growing the trees in close and extensive plantations, which gives most of them proper protection against the winds. Yet another objection is that eucalypti will not thrive generally when intergrown with other trees, and will interfere with the other trees and even kill them off; or, more rarely in these colonies, that they will be injured by the other trees. Both of these facts can be prevented by leaving sufficient space between eucalypti and the other trees.

The principal and insuperable objection to eucalypti requires also but a simple mention here: there is no money to be made from them, or, at least, such is the experience of the growers until now, the trees having been introduced into Algeria and Tunisia more than a quarter of a century ago. Those who recommended their being grown by others for a large profit have benefited by being prematurely rewarded by the government for their zeal.

Alas! that favorable prophecies, with all the calculations to support them, should have proved fallacious.

IV.

SPECIES AND VARIETIES OF EUCALYPTI MOST SERVICEABLE IN TUNISIA AND ALGERIA.

Among the very numerous species and varieties of eucalypti, our choice is founded on the recent study and actual knowledge of the trees. *Eu. globulus* (blue gum) grows well enough in generally dry soils,* and yet is especially suited to damp subsoils; its leaves and fruit are rich in essential oil and it is abundant in its indigenous soil, Australia. We owe the fact of its being the first species introduced into northern Africa to these advantages, as mentioned in our second chapter; also to the fact that there was at the time a relative, if not absolute, ignorance of the merits of the more valuable and equally hardy or even hardier species (which are still not sufficiently known in these colonies). But its wood is inferior for any purpose, as is fully stated elsewhere, and the red gums have been generally preferred within the last few years.

We refer at length in our last chapter to the many qualities of *Eu. marginata*, which is as yet so extremely rare as to be scarcely noticeable in a practical nomenclature of species found here.

Among the most remarkable species of red gums grown here are *Eu. rostrata* and *Eu. resinifera*, and numerous hybrids or crosses of these species. The former, when extensively grown from the seed and planted out, furnishes a good wood, withstands the dryness of the summer in the interior, seems to be one of the most resistant of trees, and reproduces itself spontaneously in the coast region (where, probably, it will soon be-

* Nevertheless it sometimes dies suddenly without apparent cause after attaining a considerable size.

come acclimated). The latter withstands intense drought and requires deep and dry soil.

Besides the above species, among the most robust and advantageous to northern Africa, according to Dr. Trabut, are the following:*

- Eu. tereticornis.*
- Eu. amigdalina.*
- Eu. botryoides.*
- Eu. colossea (Eu. diversicolor).*
- Eu. cornuta.*
- Eu. corinocalyx* (dry soils).
- Eu. gomphocephala* (still rare, but most useful).
- Eu. goniocalyx.*
- Eu. leucoxylon (Eu. sideroxylon).*
- Eu. maculata.*
- Eu. mülleri.*
- Eu. occidentalis.*
- Eu. polyanthema* (Shaw), *Eu. populnea* of Müller, *Eu. populifolia* of Hook, etc.
- Eu. rostrata* (brackish swamps).
- Eu. robusta.*
- Eu. romeliana* (hybrid from *Eu. botryoides* and *Eu. rostrata*, leafy and strong, obtained by Dr. Trabut).
- Eu. rufa* (large capsules).
- Eu. soligna.*
- Eu. viminalis.*

V.

WHERE, WHEN AND HOW TO GROW EUCALYPTI IN THESE COLONIES.

Where to grow them. Eucalypti, like *Acacia*, *Mimosa*, and plane trees, thrive in countries where there are but two defined seasons ; yet in Algeria and Tunisia they are only to be grown in the coast region, especially in the larger valleys and on the hillsides. Neither the extreme cold of winter on the high plateaux of the central zone, nor the extreme heat of the southern or Saharan zone and the changes between the temperatures of day and night, are suitable to them. Adaptable to widely different conditions of temperature, according to species and to the composition, depth, dryness or dampness of the soils in different parts, yet, in the words of Sir Lambert Playfair,† it would be

* Dr. Trabut, Professor of Botany at the Écoles Supérieures, Algiers.

† Sir Lambert Playfair, Consul General of Great Britain at Algiers, Report on the planting of Eucalypti in Algeria, May 16, 1877, No. 21.

"as useless to attempt to grow them in the Tropics as it would be in the north of Scotland."

For species suitable to special soils see preceding chapter. Generally speaking, eucalypti should be grown throughout Algeria and Tunisia, preferably in swampy localities, on the shores of lakes, around ponds either shallow or brackish and partly dry in summer, in damp bottom lands, on the banks of water courses which are sluggish or frequently changing their beds (as are most north African rivers, which often ruin whole valleys that might be fertile under other conditions), in places exposed to landslides or slips, for they are generally not on a large scale, although frequent on account of the abundant clay of the coast region. We have seen also that they aid in protecting villages and farms against noxious winds, sun and the malaria, whether bred *in locis* or in the neighborhood. Finally eucalypti are advantageously grown in any appropriate soil of little value for other purposes, if a judicious choice be made among the species. Whatever be the locality chosen, the surface soil must be permeable and otherwise suitable; the subsoils, if compact, force the roots to spread out mesh-like to considerable distances, sixty metres as we have measured, in the direction of water or of deeper and better or damper soil.

Where not to grow them. Without a ditch of a couple of metres in depth being dug as a separation between eucalypti and the other more valuable plant, no eucalypti, particularly not *Eu. globulus*, should be grown near these plants (orange or other fruit trees, vines, flower beds, etc.), nor too close to a spring (always most precious in these colonies), a well, a reservoir, a building or any useful wall, as eucalypti send out roots which absorb the nourishment of other plants, and sometimes ruin constructions even of cement.

Three modes of propagation. Eucalypti are grown from seed, either sown *in loco*, in the open field where the trees are to remain, or, preferably in Algeria and Tunisia, the seed should be sown in pans, the young trees being planted out properly and at the proper time; or they are grown from young trees.

The seeds take from fifteen to twenty days to germinate, according to soil and season. They are small, light and generally fertile. They should nowhere be covered by more than a centimetre of finely divided earth.

Water is generally scarce in Algeria and Tunisia, and artificial irrigation being expensive, cannot be attempted, if the plants are to be grown on a large scale.

Preparation of the ground for sowing and planting. For both sowing and planting, the ground should be prepared several months before the seeds or the trees are consigned to it. The soil should be broken up by a subsoil plough to a depth of 0.05 metre or more, when possible, and all foreign growths removed.

Sowing in the open.

Shortly before sowing in the open, the ground should be ploughed crosswise, that is in both directions, and reploughed lightly in furrows 1.5 metres apart. The seeds should be carefully deposited every two steps (or at intervals of 1.5 metres) and covered with a thin layer of fine earth. Of course, this entails irregularities in the interspacing of the shoots, as many seeds do not germinate, being blown or washed away or washed under, and the young plants of the same species grow more or less rapidly, according to the quality of the surface soil, and in a lesser degree to the nature of the subsoil in various places in the same localities, and moreover the growth is less rapid for some time than when young shoots are planted. This sowing in the open, which should take place at the beginning of the rainy season, appears to be cheaper than sowing in pans and planting out the young trees a few months old, the labor being so much less, but in the end it is dearer as so many seeds do not germinate, and the sowing has to be renewed frequently.

Sowing in pans to plant out the shoots.

The seeds are preferably sown in pans or boxes, and the young trees planted out at the proper age and season.

"Prepare a compost of vegetable mould and river sand very finely sifted. Fill the pots of 0.15 metre in diameter, press the earth lightly and evenly with a small zinc cylinder of about the same diameter as the pot. Scatter the seed on the surface so as nearly to cover the whole of it, then, with a very fine sieve, which may be a zinc cylinder similar to the other but perforated with very minute holes, sift just enough of the compost on the seed to cover them and no more. Press this surface again lightly with the first cylinder and water with a watering pot, the rose of which is perforated with the smallest holes which it is possible to make. This should be done in early May, so that the trees may be planted out at the first rains of autumn when the ground is moist. Within fifteen or twenty days the seeds will have germinated, and in about six weeks the plants will be ready to put out. Weed off as soon as the trees have produced four leaves, and transfer to other pans of 0.1 metre in diameter, to be kept in a shady place for the first day or two, and then transfer to a sunny position; water during the summer just sufficiently to prevent them from dying. The great object is to retard their growth during the summer so as to keep them small and prevent their roots from becoming matted inside of the pans.

A second sowing may take place about the middle of September, so as to obtain young plants ready to be put into the ground about the beginning of spring. In some respects this plan is preferable to the other, and it is always so when the plants can be watered in summer. The young trees have a shorter time to remain in the pans, and their roots run less chance of becoming matted; but often, when the rains cease early in the year, they have not become sufficiently rooted in the open

to enable them to resist the heat of summer without occasional irrigation.

"The Eucalyptus is a plant that does not stand being kept long in a pan ; its roots grow with as great rapidity as the rest of the tree, and, if they are allowed to be contorted round the inside of the pan, the tree does not recover from this unnatural condition of things and seldom grows straight and healthy."

As previously stated, as soon as the ground (which

Planting in the open on a large scale. has been broken up and freed from other growths, late in the winter or early in the spring while wet) becomes again impregnated with the rains of autumn, plough and plant out the young trees of three to five months' growth (which have often five to eight leaves each), at inter-spaces of four metres in trenches, and as they increase in height, progressively fill in the trenches, till in six months they have entirely disappeared, and instead of a depression, the earth becomes piled up round the stem of the young trees; this serves not only to keep the roots moist, but to prevent the slender stem from being blown over by heavy winds against which eucalyptus should always be protected as much as possible to prevent twisting and a slow growth.

It is well to give each plant a good watering when put into the ground, but they will generally not require another (?).* The soil should be kept free from weeds and open for the first two or three years, which may be conveniently done by passing a cultivator between them in each direction once or twice a year. After the third year they may be left to themselves and will require no further care.

"Weakly specimens are eliminated wherever necessary and their places filled with hardy plants, until a full plantation of trees is obtained from four to five metres apart."

Planting on a small scale. When eucalypti are to be planted on quite a small scale, instead of trenches, holes of a cubic capacity of 0.5 metre may be made ; but this is not to be recommended in the open field, as the heavy rains are apt to fill up the holes with earth and smother the plant, instead of being carried off by the open trenches above described.

Definite aspect of a plantation. "By judicious management plantations can be obtained in which the trees are about four metres apart, and after ten years or so, every alternate row in its entirety may be cut down, leaving the remaining trees at eight metres apart."

* It sometimes happens, when the rains cease early in the year, that the young eucalypti have not become sufficiently rooted during their short sojourn in the open ground to enable them to resist the heat of summer without occasional irrigation.

VI.

COMMERCIAL VALUE OF EUCALYPTI IN ALGERIA AND TUNISIA.

Pecuniary profit from the trees generally. The retail price of *Eu. globulus*, much the most abundant among eucalypti in Algeria, when cut up for fuel and sold in Algiers is \$0.50 a quintal (100 kilogrammes = 220 pounds), and yet we have been offered by the trade for full-grown trees the same sum, all expenses of cutting down, sawing and splitting into hearth-logs, as well as of carting to town being assumed by the buyer.* The road to town is good, down hill and only four miles long, and the cost of transportation is estimated at about ten cents a quintal. If the road to market is not very short and good, the trade will not buy standing eucalypti at any price, as there is no profit, and frequently a positive loss in the transaction, and in the immediate proximity to any good market the purchaser has to pay too high a price for his land to grow eucalypti for sale.

Thus we see that the business scarcely exists at all on any scale worth a longer notice here. And yet firewood is generally wretched in the coast region, good wood being procurable only in the mountains where, with the exception of the several military roads which are admirable, the roads are few and bad. All fuel is therefore relatively dear, because until now no coal mines have been worked, although several are said to exist in the colonies.

In the towns and even in Algiers old boxes, rafters from torn-down houses and ragged roots of lentiscus are offered and bought as fire wood.

Details as to expenses of growing the trees, and margin of profit or loss. Counting 800 trees to the hectare (2 acres 1 rood 35 perches) left after ten or twelve years, if the trees are then marketable (as they rarely are under the most favorable conditions and circumstances), we have, at say 50 cents each, \$200 for the product of an hectare for ten years, or \$20 a year, that is, about \$9 a year for the acre. From this sum, if we subtract the cost of growing the trees in the most economical way, which is one-twentieth if the trees are grown from the seed planted *in loco* (as previously noted), and which may be estimated at \$4 a year per acre; and the interest on the price of the land and other incidental expenses, we find no profit left, or even a pecuniary loss, unless we start with very cheap or free land, most favorably and exceptionally well situated and with 2000 trees per acre, to be weeded out during the first five or six years: and unless we can sell these younger trees, which is a very rare occurrence, the trades preferring other woods

*These trees were thirty years old, but under the most favorable conditions the trees would possibly have brought the same price at fifteen.

for the numerous uses to which eucalypti are put in Australia, doubtless for want of better wood.*

**A small market
for the accessory
products of euca-
lypti.**

Not only is there, generally, no profitable market for the wood of eucalypti in Algeria and Tunisia, but there is a very small sale of the undoubtedly important accessory products of these trees.

From the leaves, twigs and fruits, giving the essential oil, there is still a little profit. For the oil when produced by the colonist the demand is relatively small compared to what it should be, high prices being asked for it by the retail dealers.† As to the tannin, it is not used in Algeria and Tunisia, nor in France, as it is in Spain and Portugal for the tanning of leather; while the tannin of *Mimosæ*, or mimitannic acid, is recognized as a most efficient aseptic and antiseptic, rendering valuable services in therapeutics, and successfully used in diphtheria by Dr. Bourlier, the discoverer, and others, as prepared by C. Brenta, of Algiers.

**Possibility of
some choice spe-
cies being pecu-
liarly profitable
in the future.**

Perhaps some choice species of eucalypti, such as *Eu. marginata*, *Eu. leucoxylon* (the black variety), will redeem the reputation of the trees as a source of pecuniary profit, when grown under the most favorable conditions and circumstances. Until now, however, nothing worth recording has been accomplished with this

* In Australia, as stated by M. Ernest Lambert, ex-Inspector of Forests in Algeria, eucalypti are in general use for manufacturing such implements as pitchforks from young trees two years old, whip handles, the handles of spades, hoes, sledgehammers and other articles of daily use. Three-pronged pitchforks, always relatively dear, are readily procured from the young trees, the stem of which is broken off or cut off and the leaves of which are stripped from the two side branches of such trees, or a branch is pinched so as to distribute the sap as regularly as possible in the three forks thus obtained. At three and four years old the trees make carriage poles or shafts, ladder poles, fence poles and rails, wheel spokes and other articles too numerous to be recapitulated here. At five years telegraph poles are obtained, which the above-named author and others affirm to be more durable than pine poles, and not to need to be injected by a preservative substance to enable them to last. The pine poles are only procurable from trees of twenty-five years' growth, during which, say the above-mentioned authors, eucalypti give five fine poles to one tree. For supports in mines eucalypti have also their places well defined, as, indeed, for railway sleepers, five or six of which are to be had from trees of seven or eight years of age. At nine they serve as piles for docks and quays. When cut up at this age they are serviceable for wheel naves, carriage brakes and drays and what not, according to the same panegyrists.

† This oil is worth about \$3 a kilogramme at Grasse, France. The parts of eucalypti employed in its manufacture yield 2 per cent. in weight, while 10,000 kilogrammes of the petals of roses and 700 kilogrammes of those of geranium yield but a kilogramme of these more valuable oils.

Many products, of doubtful origin, actually used in perfumery under fanciful names, of supposed Japanese and other origins, seem to have no other merit (when they are not positively offensive to the sense of smell) than their supposed scarcity and consequent expensiveness. Eucalyptol, if rare or still supposed to be, would doubtless be sought by the extravagant public as an agreeable exotic perfume. It would have the merit of being a clean product of great virtue for the toilette, which is more than can be said of any of these so-called perfumes—and, united in due proportions with pure white vaseline and good toilette soap, it should be extensively used for toilet purposes.

species, excepting the interesting experiment made by Dr. Bourlier on his farm near Reghaia, where a few of this species have been successfully grown, conjointly with divers *Acaciæ* and especially with *Mimosæ*.

**Desirability of
the propagation
of such fine spe-
cies as *Eu. mar-
ginata*.**

Algeria and Tunisia, which have so far not been blessed with any such treasure.*

**Alleged blind-
ness of the pub-
lic and market
to the merits of
eucalypti in gen-
eral.**

It is a pity that, with the exceptions mentioned in this paper, the very many merits claimed years ago, and still claimed by some, for eucalypti in general, should remain unrecognized in Algeria and Tunisia by those who have been induced to make the experiment of growing eucalypti for profit. Either the public and the market are blind to the merits of eucalypti, or else the numerous services rendered by these trees are still better rendered by others at present in use for agricultural and industrial purposes, as well as for fuel. It is needless to mention which of these suppositions is the most likely.

*On the Remains of the Foreigners Discovered in Egypt by Mr.
Flinders-Petrie, 1895, now in the Museum of the
University of Pennsylvania.*

By Mrs. Cornelius Stevenson.

(Read before the American Philosophical Society, March 20, 1896.)

Before entering upon my subject, I must explain that what information I have with regard to this remarkable collection is mainly derived from private letters received from Mr. Flinders-Petrie last winter at the time of this most brilliant of all his brilliant discoveries, and at intervals since then. Very little has, as yet, been published concerning them. The

* Like the reed of the fable, *Eu. marginata* is flexible and bends readily without breaking. A block of 0.5 metre in length and offering a square section of 0.25 metre bears, before breaking, a weight of 1400 kilogrammes suspended from its middle, 900 kilogrammes being the breaking weight of a ruler of oak of the same dimensions. The resistance of *Eu. marginata* to crushing in the same condition is also greater than that of oak (both woods having the same density), and is 350 kilogrammes to the square centimetre of bearing surface; its tensile strength is remarkable, 890 kilogrammes to the square centimetre. Its resistance to parasites is very great, even the terrible white ant cannot perforate its grain, nor does the *Teredo navalis* cause its prompt destruction, as is the case with other woods used in naval constructions, for *Eu. marginata* has been known to withstand the action of the ship worm for thirty and forty years (E. Lambert, above quoted).